

PROCEEDINGS
OF THE
CALIFORNIA ACADEMY OF SCIENCES
FOURTH SERIES

Vol. XXXVI, No. 19, pp. 551-570; 35 figs.

May 7, 1969

THE SHORE FLIES OF THE GENUS
CANACEOIDES CRESSON
(DIPTERA: CANACEIDAE)

By

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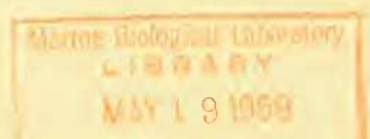
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Although I reviewed the known species of the genus *Canaceoides* Cresson previously (Wirth, 1951, 1954) and attempted to separate them from *Nocticanace* Malloch, the genus has remained poorly understood and in need of revision. Receipt of an extensive collection of canaceids obtained on the Sefton-Orca Expedition of the California Academy of Sciences in Baja California now makes such a revision possible. The purpose of the present paper is to note better characters for the separation of the two genera, to point out key characters for recognition of the species of *Canaceoides*, and to describe eight species new to science.

I am greatly indebted to Dr. Paul H. Arnaud, Jr., of the California Academy of Sciences (hereafter abbreviated CAS) in San Francisco for the opportunity to study this fine collection. I am also greatly indebted to Dr. D. Elmo Hardy of the University of Hawaii in Honolulu (abbreviated HAW) and to Dr. J. R. Vockeroth of the Entomology Research Institute, Canada Department of Agriculture, Ottawa (CAN), for the loan of large collections of Hawaiian Canaceidae. Unless otherwise noted, the other material upon which this study is based is in the U. S. National Museum (USNM) in Washington, D. C.

The known species of *Canaceoides* are found on tidal rocks and beaches, and in tidal pools along seacoasts. Williams (1938) gave the best account of their habits and life stages. The larvae are saprophagous or feed on bits of algae from the intertidal rocks or beaches.

Although superficially very similar, the genera *Canaceoides* and *Nocticanace*



differ in a number of characters that I regard as having generic importance, and these differences are reinforced by the distribution patterns of the two genera. *Nocticanace* has a wide distribution, mainly Pacific, but extending westward to Madagascar and South Africa and eastward across the Isthmus of Panama to the Caribbean and the Atlantic Coast of North and South America. *Canaccooides*, on the other hand, is restricted to the Pacific Coast of the Americas, except for two species found in the Hawaiian Islands.

The two genera differ in the following important points:

Nocticanace:

1. Three pairs of strong genal bristles present, plus a fourth (and rarely more) small seta ventrally out of line.
2. Disc of scutellum without hairs.
3. Distal spines of tarsomeres three and four not flattened (except in *N. arnaudi* Wirth and *N. texensis* Wheeler).
4. Female eighth tergum with two very long marginal hairs, reaching apices of the genital lamellae.
5. Female genital lamellae without long fine hairs on dorsal side; with two long hairs at apex.
6. Female atrial sclerotization oval in outline.
7. Male genital process separated from ninth tergum by a suture or constriction, shaped variously, usually not bilobed.

Canaccooides:

1. Four pairs of strong genals present.
2. Disc of scutellum with 2–15 hairs.
3. Third and fourth tarsomeres each with distal pair of broad, flattened, ventrally concave, spatulate spines.
4. Female eighth tergum with a row of small subequal hairs on posterior margin.
5. Female genital lamellae with long fine hairs on dorsal side; with one long hair at apex.
6. Female atrial sclerotization U-shaped, incomplete on posterior end.
7. Male genital process not separated by a constriction or suture from ninth tergum but divided into two spinose lobes.

Canaccooides probably evolved from a stock similar to *Nocticanace arnaudi*, a California species intermediate in many respects between the two main groups of *Nocticanace* species. One of these groups developed in the western Pacific and Indian Ocean coasts; the second group is characteristic of the Atlantic and Caribbean coasts of the Americas and the Pacific coasts of South and Central America. Speciation has not resulted in the development of any striking external morphological characters in *Canaccooides* as it has in the American *Nocticanace*. The differences between the species of *Canaccooides* are mainly in the structure and armature of the male and female internal genitalia, with now and then a

unique external feature such as the development of extra hairs on the scutellum or characteristic clumps of long hairs on the female genital lamellae.

Genus *Canaceoides* Cresson

Canaceoides CRESSON, 1934, Trans. Amer. Ent. Soc., vol. 60, p. 221. Type species, *Canace nudata* Cresson, original designation.

Procanace CURRAN, 1934, Proc. Calif. Acad. Sci., 4th ser., vol. 21, p. 160. Type species, *Procanace panamensis* Curran, original designation. Preoccupied by *Procanace* Hendel 1913.

Neocanace CURRAN, 1934, Families and Genera of North American Diptera, p. 357 (new name for *Procanace* Curran).

Canaceoides Cresson, WIRTH, 1951, Occ. Papers B. P. Bishop Mus., vol. 20, p. 266 (revision, syn.: *Neocanace* Curran). WHEELER, 1952, Ent. News, vol. 63, p. 91 (notes synonymy).

WIRTH, 1954, Pan-Pac. Ent., vol. 30, p. 59 (notes, compare *Nocticanace* Malloch).

DIAGNOSIS. Head short, much higher posteriorly, frons broader than long, sloping toward antennae; upper face with prominent broad carina between antennae; clypeus prominent, epistomal margin of face nearly straight, not emarginated by clypeus. Three pairs of strong laterocline fronto-orbitals, a fine hair interspaced in series anterior to each one; one pair of long procline interfrontals arising at level slightly cephalad of anterior ocellus and laterad of lateral ocelli; a pair of strong laterocline ocellars arising about midway between anterior and posterior ocelli; a pair of strong laterocline outer verticals and a pair of strong mesocline inner verticals; postverticals not developed; ocellar triangle slightly convex, more or less setose; mesofrons dull, not demarcated from rest of frons. Third antennal segment orbicular, with short, pubescent arista stout at base. Eye oblique with lower anterior corner slightly produced. Cheek moderately broad, slightly narrower below anterior corner of eye where it is about 0.33–0.53 as broad as greatest diameter of eye. Cheek bearing an oblique row of four long bristles, the row sloping downward anteriorly, the anterior bristle bent slightly forward, the other three bent upward over eye toward the fronto-orbitals. Cheek more convex along the row of bristles, genal angle slightly recessive, with a few fine hairs, often with a slightly longer one directed forward. Palpi slender, with a few long hairs near tip; clypeus not broad, slightly more than twice as broad as high, convex ventrally, clypeus about a third as high as median height of face to the top of the noselike projection, which is slightly higher than broad.

Thorax relatively narrow and high; mesonotum convex, especially between the prominent humeral convexities. Four pairs of strong dorsocentrals, the posterior pair displaced considerably laterad out of line; one pair of strong humerals; one pair of strong presuturals; two pairs of notopleurals, the anterior one usually very weak, the posterior pair moderately strong; one pair of supralars; two pairs of postalars. Scutellum moderately to quite convex, with two pairs of strong marginals and two moderately strong discal hairs, but discal hairs more numerous, as many as 15, in some species. Mesonotum usually

setose on humeri and on anterior margin laterad of dorsocentral series, bare mesad and posteriorly, a few fine hairs sometimes present on notopleuron. Mesopleuron with three strong posterior bristles and one strong ventral bristle plus scattered setae; sternopleuron with one strong bristle and a few scattered setae; propleural bristle small or absent; remainder of pleuron bare. Legs slender, without special armature, with scattered setae; femora, especially anterior pair, with moderately long hairs posteroventrally; tarsi slightly broadened distally, third tarsomere slightly bilobed apically, fourth greatly so: on fore leg, tarsomeres three and four with a pair of strongly flattened, broadened spines apically, tarsi otherwise with normal stout black spinose setae ventrally; claws strongly bent and stout near base, curving distally to sharp point; well-developed padlike pulvilli present, a small median empodium also present.

Wing uniformly infuscated; costal margin with strong black setae to tip of second vein; costa continuing, slightly weaker, to tip of fourth vein. First vein short, second, third, and fourth long; costal sections I (from humeral crossvein to tip of first vein), II (between tips of first and second veins), III (between tips of second and third veins), and IV (between tips of third and fourth veins) in ratio of 27:85:13:15 in type species. Second vein slightly arched anteriorly, third vein nearly straight, distal portions of second, third, and fourth veins virtually parallel; discal cell long and narrow, slightly broader distally, anterior crossvein perpendicular to fourth vein but forming a distinctly acute angle with tip of discal cell posteriorly; anterior crossvein located distinctly proximad of middle of discal cell, its exact location of diagnostic value between species, the three sections of fourth vein, progressing distad, in ratio of 35:60:115 (in *C. nudatus*), the fourth vein ratio (length of section III divided by length of section II) thus 1.9 (in *C. nudatus*).

Abdomen seven-segmented, the fused first and second terga usually as long as the following two or three combined; abdomen tapering distally, especially in female; without long bristles but with moderately numerous long setae.

Female postabdomen (fig. 34, lateral view) with seventh tergum (*7t*) excised dorsally, caudally produced on sides in broad lobes. Eighth tergum (*8t*) quadrate, more or less convex dorsally and caudally, usually with a row of 6–8 moderately strong hairs on caudal margin. Genital lamellae (*lam.*; cerci of Hennig, 1958, p. 660) fused at base behind caudal excision of eighth tergum; produced caudad in the form of two tapering lamellae, these slightly curved dorsad; each bearing distally two or three long, blackish, greatly thickened, or flattened and broadened spines; lamella without thickened spines proximally, but with fine erect hairs, the number, length, and arrangement of which are of specific diagnostic value (figs. 10–18). Sternal sclerites greatly reduced, narrow on proximal segments, broadening on 6, well-developed on 7. Eighth sternum (figs. 33–35, *8s*) sclerotized anteriorly, partially membranous posteriorly, but bearing on caudal margin a pair of small sclerotized plates each bearing a dense clump of

4-6 long, brown to black, stout, blunt spines, some curved, some nearly straight. Ninth sternum (figs. 19-23, 34, 9s) semi-appressed ventrally to fused bases of genital lamellae as a small, pubescent, horizontal sclerotized plate with caudolateral corners slightly bilobate. Internal to seventh sternum is a prominent narrowly V-shaped sclerite (figs. 33-35, *atr. sc.*) associated with the ventral wall of the atrium (fig. 35, *atr.*) or genital chamber, which opens posteriorly between the spinose plates on eighth sternum. Two strongly sclerotized, brown, mushroom-shaped spermathecae (figs. 24-32, 34-35) present, connected by long, slender, hyaline ducts to the anterior end of the genital chamber.

Male postabdomen with ninth tergum convex, ventral ends directed antero-ventrally against the venter, with apices prolonged in two lobes, the inner (anterior) and outer (posterior) lobes of the genital processes; each genital process (figs. 1-9) not separated from the tergum proper by a suture or definite constriction; outer lobe usually more heavily sclerotized and appearing shining on external side, some minute hyaline perforations from vestigial setae usually present on mesal side at apex, subapically with fine hairs or strong spines on mesal side; inner lobe usually with group of strong blackish spines directed mesad, relative lengths and shapes of inner and outer lobes and arrangement of the spines differing in each species.

The following key is intended for use with males for which genitalia preparations have been made, though one species has been keyed out first on the basis of scutellar vestiture. Characters for females of some species are shown in brackets as a confirmatory aid for associated females. As a further aid, the known distribution of the species occurring in the Gulf of California is mapped in figure 36.

KEY TO THE SPECIES *CANACEOIDES*

1. Scutellum with only two discal hairs (rarely with 1-2 extra hairs present) 2
 Scutellum with 6-15 discal hairs (rarely as few as two and then only in male) [female genital lamellae (fig. 15) short with dense tuft of long grayish hairs dorsally]
 *C. scutellatus*, new species
2. Outer lobe of male genital process with spines extending to tip (figs. 7-9) 3
 Outer lobe of male genital process without spines on extreme tip but with hyaline perforations present (figs. 1-5) 5
3. Inner lobe of male genital process blunt and rounded, stouter than the outer lobe (fig. 7) [dorsal hairs of female genital lamellae long and curving anteriad (fig. 16)]
 *C. setosus*, new species
 Inner lobe of male genital process more slender than the outer one, more or less finger-like (figs. 8-9) 4
4. Spines on inner lobe of male genital process extending about halfway to base of lobe (fig. 8) [dorsal hairs of female genital lamellae erect on sides, forming a prominent lateral clump (fig. 17)]
 *C. spinosus*, new species
 Spines on inner lobe of male genital process forming a compact group at extreme tip (fig. 9) [dorsal hairs of female genital lamellae all distinctly reclinate (fig. 18)]
 *C. tenuistylus*, new species

5. Inner lobe of male genital process broad and obliquely truncate distally with many very fine distal spines and coarser one proximad (fig. 1) *C. angulatus*, new species
 Inner lobe of male genital process rounded or tapering distally, not obliquely truncate (figs. 2-5) 6
6. Inner lobe of male genital process very short and slender with 4-6 sharp spines at extreme tip; outer lobe (fig. 5) slender [female genital lamellae with short, sparse dorsal hairs (fig. 14); spermathecae much broader than long (fig. 28)]
 *C. panamensis* (Curran)
 Inner lobe of male genital process at least as long as outer, not extremely slender, and bearing more than 6 distal spines (figs. 2-4) 7
7. Inner lobe of male genital process longer than the outer, blunt and stout to tip, bearing 15-20 very strong distal spines (fig. 4); [female scutellum with 5 distal hairs]
 *C. nudatus* (Cresson)
 Inner lobe of male genital process subequal in length to outer lobe, but more slender, tapering distally with no more than 10 distal spines (figs. 2-3) 8
8. Inner lobe of male genital process with 8-10 stout spines and 5-6 long proximal hairs (fig. 2); female ninth sternum (fig. 20) as broad as long *C. balboai*, new species
 Inner lobe of male genital process with 4 stout spines and 4 stout proximal hairs (fig. 3); female ninth sternum (fig. 21) 2.0 as broad as long *C. hawaiiensis*, new species

Canaccoides angulatus Wirth, new species.

(Figures 1, 10, 19, 24.)

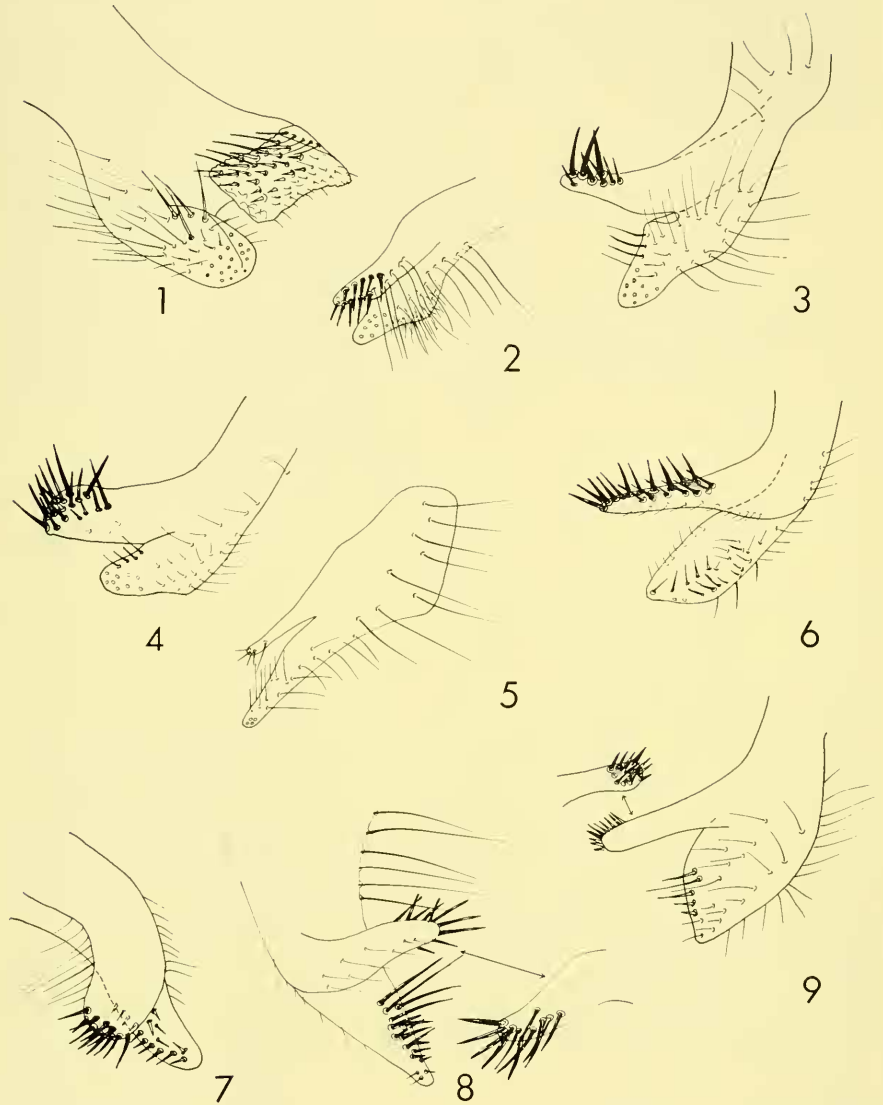
Canaccoides nudatus CRESSON; of authors, in part, misidentification.

MALE, FEMALE. Wing length, 2.1-2.4 mm.

Brownish black; frons, vertex, mesonotum, scutellum, abdominal dorsum, and legs with dark brown pollen showing violet lights; face, cheeks, occiput, humeri, pleura, frontal orbits, and an indistinct line bordering anterior part of mesofrons with grayish pollen with violet tint, appearing lighter when viewed from above; all hairs and bristles blackish. Wing uniformly infuscated dark brownish, veins dark brown; halteres yellowish white.

Width of frons at level of posterior ocelli 1.25 times the length from anterior margin to level of inner verticals; 6-8 fine hairs on and behind the moderately convex ocellar area. Narrowest portion of cheek 0.33 as broad as greatest diameter of eye. Scutellum distinctly convex, with two discal hairs. Wing with relative lengths of costal sections I, II, and III in ratio of 14:38:5; anterior cross-vein located at 0.40-0.46 of distance from base of discal cell; fourth vein ratio 2.2.

Eighth tergum of female abdomen with row of 8-10 relatively long hairs along posterior margin; genital lamellae (fig. 10) relatively short, each with 12-15 relatively long, curving hairs over dorsal surface, extending nearly to base of lamella; sternum nine with caudolateral corners produced (fig. 19); spermatheca as in figure 24. Male genital process (fig. 1) cleft distally in two blunt lobes; outer lobe distally rounded, bare at apex but with abundant fine hairs subapically on outer face; inner lobe obliquely truncated at apex, bearing a rhomboidal flattened mesal area with abundant black spines, these very short distally in series but longer on proximal portion of the platelike area.



FIGURES 1-9. Genital process of male genitalia of *Canaceoides*. Figure 1, *Canaceoides angulatus*; figure 2, *C. balboai*; figure 3, *C. hawaiiensis*; figure 4, *C. nudatus*; figure 5, *C. panamensis*; figure 6, *C. scutellatus*; figure 7, *C. setosus*; figure 8, *C. spinosus*; figure 9, *C. tenuistylus* (mesal views except fig. 5; outer lobe below, inner lobe above).

DISTRIBUTION. Hawaiian Archipelago, Baja California, Gulf of California Islands, Peru, Galápagos Archipelago.

TYPES. Holotype male, allotype female, Waimea, Oahu, 31 January 1946, W. W. Wirth, intertidal rocks (type no. 69,932, USNM). Paratypes, 268 males, 316 females, as follows: MIDWAY ISLAND: At light, 12 November 1959, 1 male. LISIANSKY ISLAND: 19 May 1923, C. Grant, 1 male, 1 female (Academy of Natural Science, Philadelphia). LAYSAN ISLAND: September 1961, G. D. Butler, 5 males, 1 female (HAW). KAUAI ISLAND: Kilauea, 8 September 1946, W. W. Wirth, on rocks in bay, 1 female. Nawiliwili, 9 September 1946, W. W. Wirth, 1 male, 2 females. OAHU ISLAND: Same data as types, 7 males, 12 females. Hauula, 4 July 1955, D. E. Hardy, 2 males. Honolulu, 11, 25 September, 20 November 1966, J. R. Vockeroth, wave swept rocks 40 males, 47 females (CAN). Koko Head, 23 July 1923, E. H. Bryan, Jr., 3 females; 25 June 1946, W. W. Wirth, 2 females. Lanikai, 29 December 1945, W. W. Wirth, 2 males, 1 female. Rabbit Island, 30 August 1946, W. W. Wirth, 1 male, 2 females. Sand Island, 22 May 1946, W. W. Wirth, light trap, 1 male. Wawamalu Beach near Koko Crater, 17 December 1922, E. H. Bryan, Jr., 1 female. MOLOKAI ISLAND: Waialua, July 1952, D. E. Hardy, 30 males, 28 females (HAW). MAUI ISLAND: Honokowai, 28 October 1966, T. Saigusa, 2 males, 2 females (CAN). Kihei, 28 October 1966, T. Saigusa, 1 male, 1 female (CAN). McGregor Point, 28 October 1966, T. Saigusa, 2 females (CAN). HAWAII ISLAND: Hilo, December 1945, W. W. Wirth, 2 females; 23 March 1967, J. R. Vockeroth, 3 males, 5 females (CAN). Kailua-Kona, 2 October 1966, W. Voss, 21 males, 31 females (CAN). Kalapana Park, 24 March 1967, J. R. Vockeroth, 10 males, 10 females (CAN). MEXICO, SONORA: San Carlos Bay, 10 August 1960, Arnaud, Ross, and Rentz, 9 males, 11 females (CAS). BAJA CALIFORNIA: Agua Verde Bay, 26 March 1953, P. H. Arnaud, Sefton-Orca Expedition, 1 male, 3 females (CAS). San Felipe, 19 February 1954, P. H. Arnaud, 19 males, 34 females (CAS). GULF OF CALIFORNIA: Isla Cerralvo, Gordas Point, 20 March 1953, 12 males, 13 females; Isla Ildefonso, 30 March 1953, 8 males, 10 females; Isla Partida, 23 March 1953, 2 males, 11 females; Isla San Francisco, 24 March 1953, 34 males, 20 females; all collected by P. H. Arnaud on Sefton-Orca Expedition, in CAS. Isla Salsipuedes, 20 May 1962, Ryckman, Ryckman, and Christianson, 10 males, 6 females. Isla San Esteban, 20 April 1921, E. P. Van Duzee, 1 male, 2 females (CAS; Academy of Natural Science, Philadelphia). GALÁPAGOS ARCHIPELAGO: Isla Pinta, southeast coast, 25 May 1964, D. Q. Cavagnaro, 22 males, 24 females (CAS). Isla Santa Cruz, Academy Bay, 24 January 1964, D. Q. Cavagnaro and R. O. Schuster, 1 female; 17 February 1964 (CAS); P. D. Ashlock, at light, 1 male, 1 female (Bishop Museum). Isla Santa Fe, 5 February 1964, T. Pappenfuss, 11 females (CAS). PERU: Lima 3 km. northwest Canete, 13 September 1954, E. I. Schlinger and E. S. Ross, 12 males, 10 females (CAS).

DISCUSSION. This species is quite distinctive in the male genitalia with both lobes of the genital process stout and blunt, the inner one bearing a distinctly flattened, spinose platelike area. The female genital lamellae are stout with abundant erect long hairs scattered dorsally. The anterior crossvein is located fairly near the middle of the discal cell (0.40–0.46 of its length), thus affording a tentative separation from the second Hawaiian species, *C. hawaiiensis*, new species, in which this ratio is 0.33–0.39.

This species is the most widely distributed in the genus; it is found from the coast of Peru in South America to San Felipe at the head of the Gulf of California, and throughout the Hawaiian Archipelago. Its occurrence throughout the Hawaiian Chain is remarkable and probably indicates that the species was transported to the Islands long before human commerce, though probably more recently than the second species, *C. hawaiiensis*, which has no exact counterpart on the American coasts.

Canaceoides balboai Wirth, new species.

(Figures 2, 11, 20, 25.)

MALE, FEMALE. Wing length, 1.55 mm.

Color and setation as in *C. angulatus*, new species. Acrostichal setae confined to extreme anterior margin of mesonotum, absent between dorsocentrals; scutellum with two discal hairs; abdominal setation sparse.

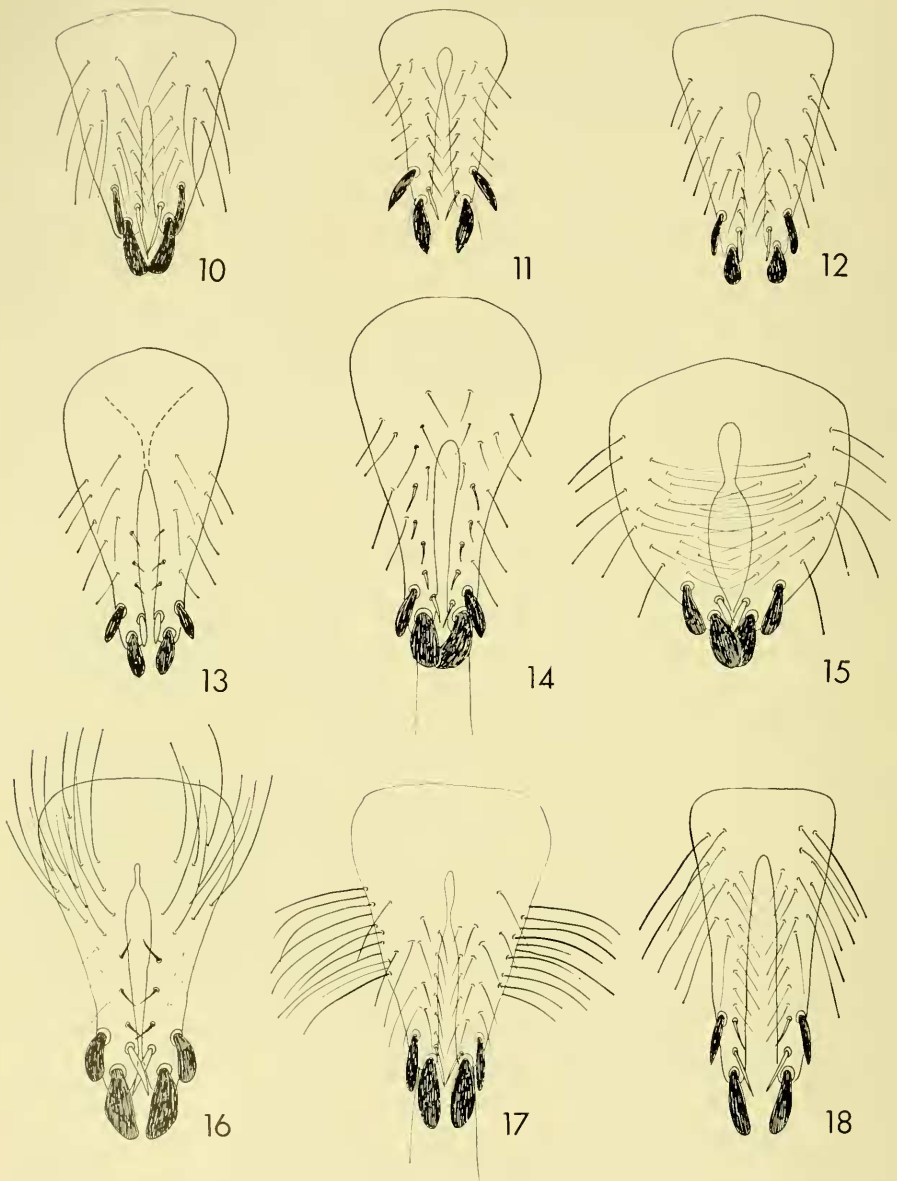
Wing with relative lengths of costal sections I, II, and III in ratio of 8:26:4; anterior crossvein located at 0.43 of distance from base of discal cell; fourth vein ratio 2.0; third and fourth veins distinctly divergent on distal portions.

Eighth tergum of female with row of 6 moderately long hairs along posterior margin; ninth sternum (fig. 20) 1.6 as broad as long; genital lamellae (fig. 11) long and slender, each with 10–15 short fine hairs on dorsal surface, those on mesal margin becoming progressively more spinelike distad; spermathecae (fig. 25) with caplike portions slightly broader than long. Male genital process (fig. 2) divided into two subequal lobes distally, the inner one with 8–10 strong sharp spines distally and 5–6 long hairs just proximad of spines; outer lobe with bare tip, proximately with long hairs and a denser group of shorter, finer hairs on a subapical swelling.

DISTRIBUTION. Panama.

TYPES. Holotype male, allotype female, on slides, 2 male and 2 female paratypes, Jaque, Darien Province, Panama, July 1952, F. S. Blanton, light trap (type no. 69933, USNM).

DISCUSSION. The species is closely related to *C. hawaiiensis*, new species, but differs in the shape of the spermathecae and in the shape and armament of the male genital processes.



FIGURES 10-18. Genital lamellae of female *Canaceoides*, dorsal view. Figure 10, *Canaceoides angulatus*; figure 11, *C. balboai*; figure 12, *C. hawaiiensis*; figure 13, *C. nudatus*; figure 14, *C. panamensis*; figure 15, *C. scutellatus*; figure 16, *C. setosus*; figure 17, *C. spinosus*; figure 18, *C. tenuistylus*.

Canaceoides hawaiiensis Wirth, new species.

(Figures 3, 12, 21, 26.)

MALE, FEMALE. Wing length, 1.8–2.1 mm.

Brownish black; dorsum and legs with dark brown pollen showing violet lights, face, cheeks, pleura, etc., with gray pollen, as in *C. angulatus*, new species.

Width of frons at level of posterior ocelli 1.45 times the length from anterior margin to level of inner verticals; 6–8 fine hairs on and behind the moderately convex ocellar area. Narrowest portion of cheek 0.31 as broad as greatest diameter of eye. Scutellum moderately convex, with two discal hairs; mesonotum nearly bare of setae, only a few on and behind humeri. Wing with relative lengths of costal sections I, II, and III in ratio of 12:34:5; anterior crossvein located at 0.33–0.39 of distance from base of discal cell; fourth vein ratio 2.0.

Eighth tergum of female abdomen with row of 6–8 only moderately long hairs along posterior margin; genital lamellae (fig. 12) moderately short, each with 12–15 short hairs scattered over dorsal surface, ninth sternum (fig. 21) gently trilobate along caudal margin; spermatheca as in figure 26. Male genital process (fig. 3) deeply cleft into two pointed lobes; outer lobe with long fine hairs subapically, bare apically; inner lobe sharply pointed with 3–4 very strong black spines and 3–4 smaller ones on distal portion toward tip.

DISTRIBUTION. Hawaiian Islands.

TYPES. Holotype male, allotype female, Hana, Maui, 20 June 1967, D. E. Hardy (in B. P. Bishop Museum, Honolulu, Hawaii). Paratypes, 85 males, 50 females, as follows: NIHOA ISLAND: 12 June 1922, E. H. Bryan, Jr., ex pools salt water, 1 male, 1 female (Academy of Natural Science, Philadelphia). KAUAI ISLAND: Nawiliwili, 9 September 1946, W. W. Wirth, 1 male. OAHU ISLAND: Hanauma Bay, 4 January 1946, W. W. Wirth, 2 males; 4 August 1950, M. S. Adachi, 2 males, 2 females. Honolulu, 24 August, 3 October 1966, J. R. Vockeroth, wave swept rocks, 29 males, 30 females. Koko Head, June 1955, D. E. Hardy, 2 males; Maile, 8 January 1946, W. W. Wirth, 1 female. Sunset Beach, 24 March 1966, light trap, 4 males, 2 females (HAW). Waianae, May 1958, Y. Kondo, 5 males, 4 females (HAW). Waimanalo, 4 August 1951, M. S. Adachi, 2 females (HAW). Wawamalu Beach, near Koko Crater, 17 December 1922, E. H. Bryan, Jr., 3 males (Academy of Natural Science, Philadelphia). MOLOKAI ISLAND: Mapulehu, Kupeke Pond, 28 August 1944, Y. Tanada, 2 males; Niaupala, 28 December 1944, Y. Tanada, 3 males, 4 females. MAUI ISLAND: Same data as types, 21 males, 2 females (HAW). Kaanapali, 28 October 1966, T. Saigusa, 5 males, 2 females (CAN). HAWAII ISLAND: Honaunau, Kona, October 1951, H. A. Bess, 13 males, 3 females (HAW); 10 February 1965, N. L. H. Krauss, on lava at edge of sea, 1 male, 3 females. Kalapana Park, 24 March 1967, J. R. Vockeroth, 1 male (CAN).

DISCUSSION. This species is readily separated from *C. angulatus* new species, which also occurs in Hawaii, by the greatly attenuated lobes of the male genital

processes, the inner lobe bearing only 3–4 very strong black spines, more or less in line near the tip of the lobe. It is also a slightly smaller species than *C. angulatus*, and the anterior crossvein is situated more proximad.

***Canaceoides nudatus* (Cresson).**

(Figures 4, 13, 27, 33.)

Canace nudata CRESSON, 1926, Trans. Amer. Ent. Soc., vol. 52, p. 257 (male, female; California). MALLOCH, 1933, B. P. Bishop Mus. Bull. 114, p. 6 (notes).

Canaceoides nudatus (Cresson); CRESSON, 1934, Trans. Amer. Ent. Soc., vol. 60, p. 221 (Hawaii). WIRTH, 1951, Occ. Papers B. P. Bishop Mus., vol. 20, p. 266 (redescribed; fig. male genitalia). WHEELER, 1952, Ent. News, vol. 63, p. 92 (notes). WIRTH, 1954, Pan-Pac. Ent. vol. 30, p. 60 (notes).

This species is a large (wing length 3.0–3.5 mm.), blackish species with two discal hairs on the scutellum in the male, four in the female. Frons at level of posterior ocelli 1.33 as broad as length from anterior margin to outer verticals. Cheek relatively broad, 0.53 as broad as greatest diameter of eye. Costal sections I, II, and III of wing with lengths in ratio of 12:33:5; anterior crossvein located at 0.33–0.39 of distance from base of discal cell; fourth vein ratio 1.9.

Female with 8–10 fine marginal hairs on eighth tergum; genital lamellae (fig. 13) long and slender, with 6–8 scattered, fine, moderately long, dorsal hairs; spermathecae (fig. 27) nearly black, each with long, conical, thick, tapering, sclerotized neck joining the globular cap to the duct. Male genital process (fig. 4) cleft deeply into two lobes of unequal lengths but subequal breadths, a short, nonspinose outer lobe, and a much longer inner lobe provided with 15–20 long, pointed, stout, black spines in a clump at apex of mesal side.

DISTRIBUTION. Washington to Baja California.

TYPES. Holotype male, 2 male and 10 female paratypes, Los Angeles County, California, 28 February 1915, M. C. Van Duzee, in Academy of Natural Science, Philadelphia.

NEW RECORDS. CALIFORNIA: Corona del Mar (Melander); Dry Lagoon Beach, Humboldt County (Arnaud); Farallon Islands (Bentinck); La Jolla (Melander); Long Beach (Melander); Pescadero, San Mateo County (Arnaud); Pismo Beach (Melander); Point Arguello (Sanders); Point Pinos, Pacific Grove (Arnaud); San Nicolas Island (Sanders); Seal Beach (Melander); Shell Beach, San Luis Obispo County (Arnaud); Stillwater Cove, Sonoma County (Schlinger). MEXICO: Ensenada, Baja California (CAS); Isla San Geronimo (Arnaud, Sefton-Orca Expedition, CAS); Punta Piedra, 30 miles north of Ensenada, Baja California (Frommer).

DISCUSSION. Hawaiian records previously reported for this species are in error, representing two new species described elsewhere in this paper. The range of *C. nudatus* is apparently restricted to the Pacific Coast of North America from Washington south to Isla Geronimo and Ensenada in Baja California, Mexico.

Canaceoides panamensis (Curran).

(Figures 5, 14, 22, 28.)

Procanace panamensis CURRAN, 1934, Proc. Calif. Acad. Sci., ser. 4, vol. 21, p. 161 (male; Panama Canal Zone).*Canaceoides panamensis* (Curran); WIRTH, 1951, B. P. Bishop Mus. Occ. Papers, vol. 20, p. 268 (male, female; from type and topotype).

MALE, FEMALE. Wing length, 1.75 mm.

Color and setation as in *C. angulatus*. Acrostichal setae strong, extending across anterior margin of mesonotum and in two rows just inside dorsocentrals to level of suture; scutellum with two discal hairs, but four present in one female; abdominal setation strong but sparse.

Wing with relative lengths of costal sections I, II, and III in ratio of 11:31:5; anterior crossvein located at 0.43 of distance from base of discal cell; fourth vein ratio 2.4; third and fourth veins slightly diverging on distal portions.

Eighth tergum of female with row of 14 moderately short hairs along posterior margin; genital lamellae (fig. 14) long and slender, each with 8–10 relatively short, fine hairs over dorsal surface, a row of 4–5 spinose hairs on dorsal side of lamella; ninth sternum (fig. 22) with posterior margin straight, a round membranous area in midportion; spermathecae (fig. 28) very short and broad. Male genital process (fig. 5) deeply cleft distally in two slender lobes of unequal lengths; the short inner lobe with 5–6 sharp spines distally; the long outer lobe bare at apex but subapically with scattered long hairs which continue to base of process.

DISTRIBUTION. Panama.

TYPE. Holotype male, Patilla Point, Canal Zone, 15 January 1929, C. H. Curran (in American Museum of Natural History).

NEW RECORDS. PANAMA: Kobbe Beach, Canal Zone, July 1967, W. W. Wirth, intertidal rocks, 2 males, 1 female. Vieque Cove, Panama Province, 7 October 1952, F. S. Blanton, 1 female.

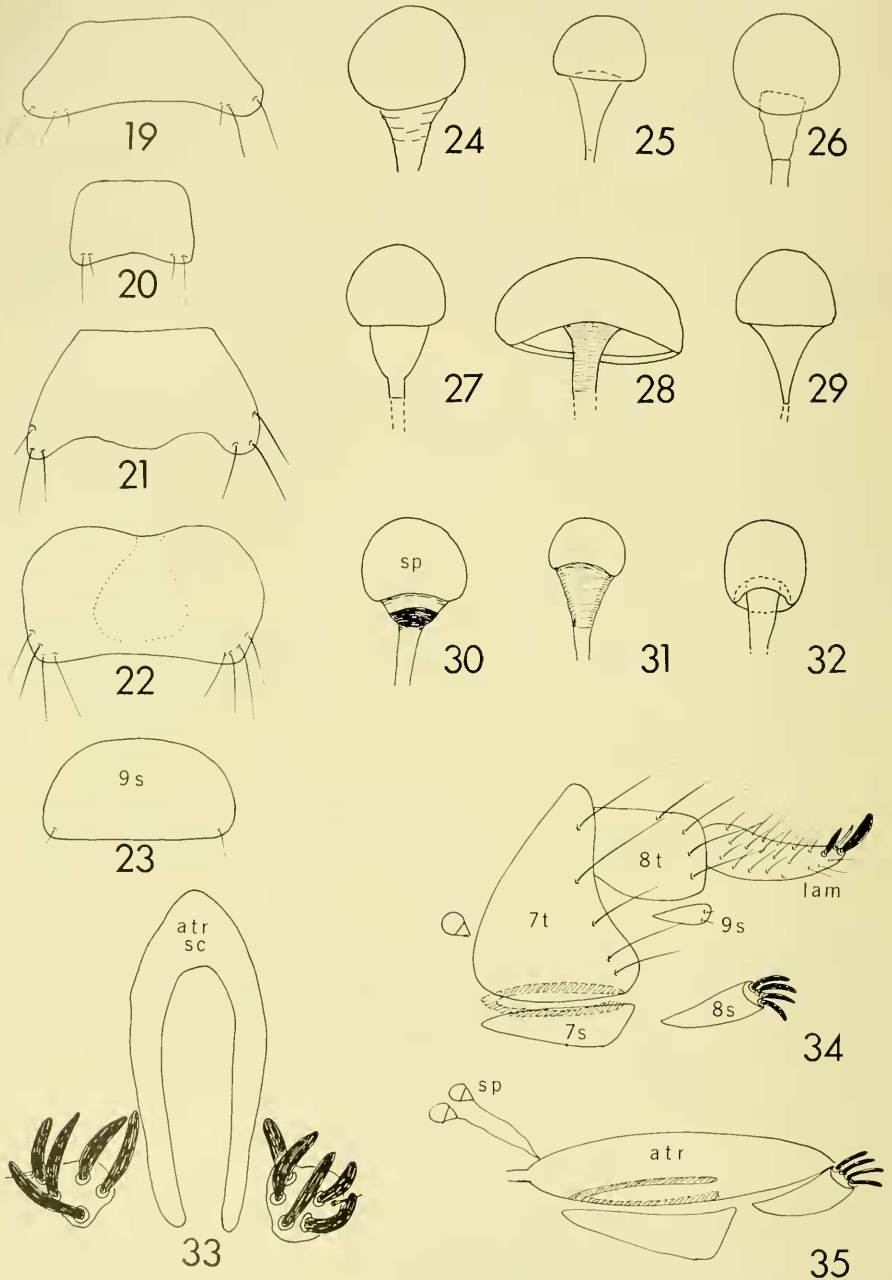
DISCUSSION. This species is similar to *C. tenuistylus*, new species and *C. balboai*, new species, from which it can be distinguished by the structure of the male genital processes and the female genital lamellae and spermathecae. The two related species also have the acrostichal setae absent except on the extreme anterior margin and the setae between the frontal bristles are very weak.

Canaceoides scutellatus Wirth, new species.

(Figures 6, 15, 29.)

MALE, FEMALE. Wing length, 2.3–2.7 mm.

Brownish black; frons, vertex, mesonotum, scutellum, and abdominal dorsum with dark brown pollen showing faintly purplish lights, gradually merging into grayish pollen with violet tint on face, cheeks, occiput, humeri, pleura, legs, and sides and venter of abdomen; pollen of face, clypeus, and cheeks whitish when viewed from above; mesofrons concolorous with rest of frons; all hairs and



FIGURES 19-35. *Canaceoides* species, female genitalia. Figure 19, *Canaceoides angulatus*, ninth sternum; figure 20, *C. balboai*, ninth sternum; figure 21, *C. hawaiiensis*, ninth sternum; figure 22, *C. panamensis*, ninth sternum; figure 23, *C. tenuistylus*, ninth sternum (9 s. = ninth

bristles blackish. Wing uniformly infuscated dark brown, veins dark brown; halteres yellowish white.

Width of frons at level of posterior ocelli 1.1 times the length from anterior margin to level of verticals; 8–12 fine hairs on and near the moderately convex ocellar area. Narrowest portion of cheek 0.37 as broad as greatest diameter of eye. Scutellum very convex, with 6–15 very strong discal hairs, often as long as the marginals, more numerous in female, rarely as few as 2–4 hairs in males. Wing with relative lengths of costal sections I, II, and III in ratio of 9:23:4; anterior crossvein located at 0.44–0.50 of distance from base of discal cell, fourth vein ratio 2.1.

Abdomen with female seventh tergum excised above, its dorsal length about a third of that on the lateral lobes; eighth tergum with scattered short hairs only; genital lamellae (fig. 15) short, stout at base, bearing a dense group of 15–20 moderately long fine hairs along dorsal surface. Female spermathecae as in fig. 29. Male genital process (fig. 6) deeply cleft distally, the outer lobe relatively broad and bearing pale spinose hairs, the inner lobe very slender and fingerlike, bearing 10–15 very prominent stout black spines on mesal side along its entire length.

DISTRIBUTION. Gulf of California (Isla Ildefonso).

TYPES. Holotype female, allotype male, on pins, Isla Ildefonso, Gulf of California, Mexico, 30 March 1953, P. H. Arnaud, Sefton-Orca Expedition (deposited in CAS). Paratypes, 156 males, 220 females, same data as types.

DISCUSSION. This species is easily recognized by the hairy scutellum which bears 6–10 strong discal hairs in addition to the four marginal bristles. The long, slender, strongly spinose inner lobe of the male genital process and the short female genital lamellae, which bear a dense group of long fine hairs dorsally along their entire length, are also distinctive.

Canaceoides setosus Wirth, new species.

(Figures 7, 16, 30.)

MALE, FEMALE. Wing length, 3.0–3.4 mm.

Brownish black; frons with dark purplish pollen; mesonotum and scutellum with dark brown pollen showing faintly violet lights; face, cheeks, occiput, humeri, pleura, legs and abdomen with grayish pollen showing violet tints; pollen

←

sternum); figure 24, *C. angulatus*, spermatheca; figure 25, *C. balboai*, spermatheca; figure 26, *C. hawaiiensis*, spermatheca; figure 27, *C. nudatus*, spermatheca; figure 28, *C. panamensis*, spermatheca; figure 29, *C. scutellatus*, spermatheca; figure 30, *C. setosus*, spermatheca (sp. = spermatheca); figure 31, *C. spinosus*, spermatheca; figure 32, *C. tenuistylus*, spermatheca; figure 33, *C. nudatus*, U-shaped sclerite of atrium and sclerotized plates of eighth sternum (atr. sc. = atrial sclerite); figure 34, schematic lateral view of terminal abdominal segments (lam. = genital lamella; 7 s. = seventh sternum; 7 t. = seventh tergum; 8 s. = eighth sternum; 8 t. = eighth tergum; 9 s. = ninth sternum); figure 35, schematic lateral view of atrium and associated structures (atr. = atrium; sp. = spermatheca).

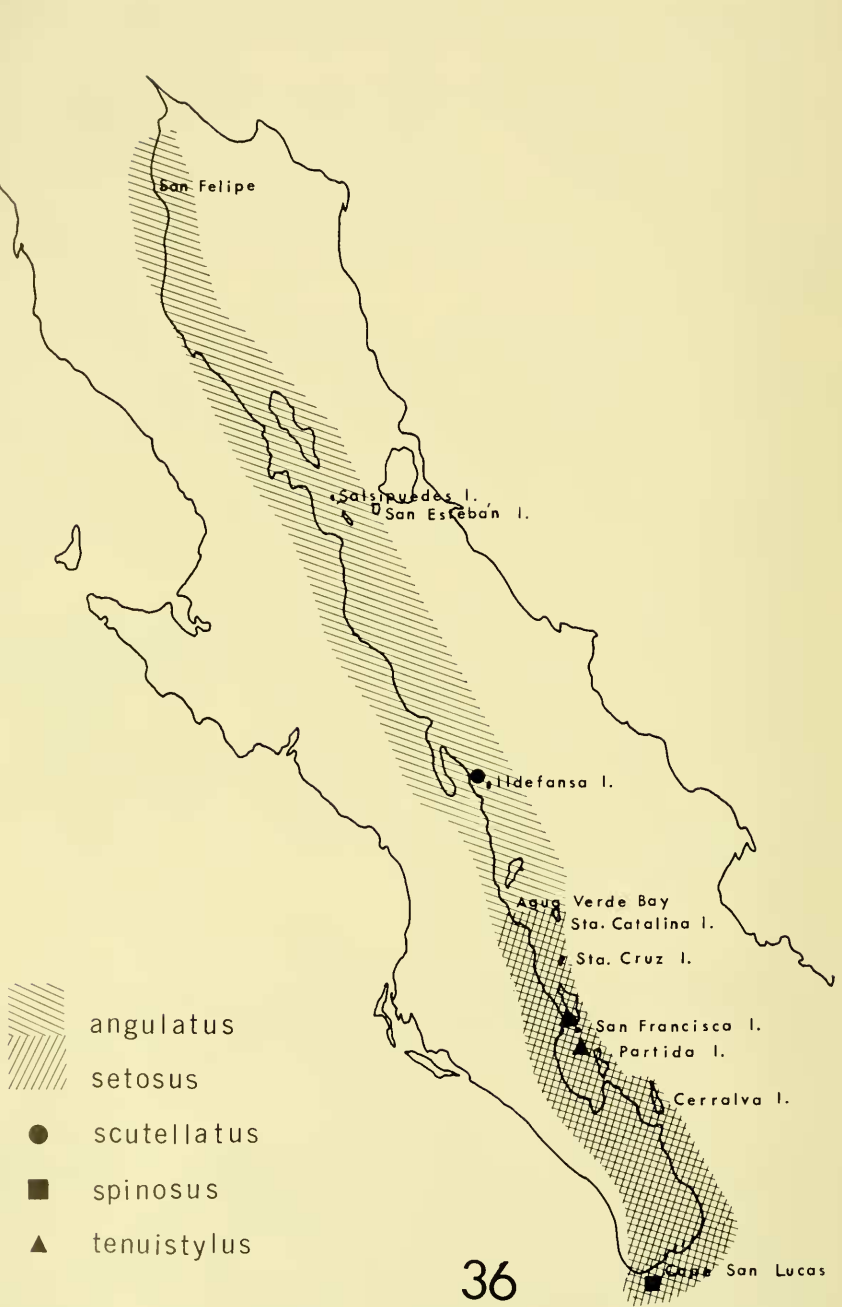


FIGURE 36. Distribution of species of *Canaceoides* in the Gulf of California.

of face, cheeks, humeri, and pleura whitish when viewed from above; mesofrons concolorous with rest of frons; all bristles and hairs blackish. Wing uniformly infuscated violet grayish brown, veins dark brown; halteres yellowish white, slightly darker at base of stem.

Width of frons at level of posterior ocelli 1.3 times the length from anterior margin to level of outer vertical; 8–10 long fine hairs scattered in the moderately convex ocellar area. Narrowest portion of cheek 0.39 as broad as greatest diameter of eye. Humeri each with 12–15 strong setae; anterior margin of mesonotum with 10–15 long setae on each side laterad of dorsocentral series only; scutellum with two long hairs on disc. Fore femur with numerous long posteroventral hairs. Wing with costal sections I, II, and III in ratio of 11:32:2, anterior crossvein located at 0.40–0.46 of distance from base of discal cell; fourth vein index 2.1.

Abdomen of female with seventh tergum excised above, its dorsal length about a third of that on the lateral lobes; eighth tergum very convex, bearing a dense clump of 10–15 long, posteriorly curving hairs; genital lamellae (fig. 16) moderately short, bent downward, on dorsal margin 3–4 short, sharp, black, spinose hairs, and at extreme base a clump of 8–10 long, slender hairs with apices curved dorsad to meet the hair tuft of eighth tergum; spermathecae as in figure 30. Male genital process (fig. 7) cleft distally in two blunt lobes; outer lobe stouter and slightly prolonged in a rounded point externally, with vestiture of pale short pointed spines and fine setae only; inner lobe with rounded apex bearing a clump of 8–12 long, stout, blackish spines.

DISTRIBUTION. Gulf of California (Isla Partida, Isla San Francisco, Isla Santa Catalina, Isla Santa Cruz); Baja California (Cabo San Lucas).

TYPES. Holotype female, allotype male, on pins, Isla Santa Catalina, Gulf of California, Mexico, 27 March 1953, P. H. Arnaud, Sefton-Orca Expedition (deposited in CAS). Paratypes, 110 males, 130 females, as follows, all collected by P. H. Arnaud, on the Sefton-Orca Expedition, in CAS: BAJA CALIFORNIA: Cabo San Lucas, 16 March 1953, 1 male, 12 females. GULF OF CALIFORNIA: Same data as types, 107 males, 114 females. Isla Partida, 23 March 1953, 3 males, 1 female. Isla San Francisco, 24 March 1953, 1 male, 1 female. Isla Santa Cruz, 26 March 1953, 1 male, 3 females.

DISCUSSION. This is a relatively large species (wing 3.4 mm. long) and easily recognized in the female by the clumps of long, curved hairs on the eighth tergum and bases of the genital lamellae; the male is more difficult to recognize, but when dissected, the distal lobes of the genital processes are distinctive, the shorter inner one being bluntly rounded with a distal clump of long black spines.

***Canaceoides spinosus* Wirth, new species.**

(Figures 8, 17, 31.)

MALE, FEMALE. Wing length, 2.3 mm.

Color and setation as in related species. Acrostichal setae absent; scutellum

with two discal hairs. Wing with relative lengths of costal sections I, II, and III in ratio of 12:39:6; anterior crossvein located at 0.43 of distance from base of discal cell; fourth vein ratio 2.45; third and fourth veins parallel on distal portions.

Eighth tergum of female with row of 5–7 relatively short hairs on posterior margin; genital lamellae (fig. 17) moderately long, each with rather dense clump of erect, laterally projecting hairs for about half of its length on mid-portion; ninth sternum with posterior margin slightly concave posteriorly; spermathecae (fig. 31) with globular caplike portion rather small in proportion to the long, tapering neck. Male genital process (fig. 8) deeply cleft in two lobes of subequal lengths, but inner lobe much more slender and bearing a clump of 10–12 strong spines distally, the stouter, distally tapering outer lobe bare at tip but bearing a subapical group of more than a dozen stout spines, of which the distal ones are short, the proximal ones long.

DISTRIBUTION. Baja California, Mexico (Cabo San Lucas).

TYPES. Holotype male, allotype female, Cabo San Lucas, Baja California, 16 March 1953, P. H. Arnaud, Sefton-Orca Expedition (deposited in CAS). Paratypes, 7 males, 17 females (pinned), same data.

DISCUSSION. This small species with slender female genital lamellae can be distinguished by the shape and armature of the lobes of the male genital process and by the clump of erect, laterally directed hairs on the female lamellae.

Canaceoides tenuistylus Wirth, new species.

(Figures 9, 18, 23, 32.)

MALE, FEMALE. Wing length, 1.7 mm.

Color and setation as in related species. Acrostichal setae confined to extreme anterior margin of mesonotum; scutellum convex, with two discal hairs. Wing with relative lengths of costal sections I, II, and III in ratio of 58:155:20; anterior crossvein located at 0.37 of distance from base of discal cell; fourth vein ratio 2.3; third and fourth veins distinctly divergent on distal portions.

Eighth tergum of female with irregular row of 7 moderately long hairs along posterior margin; genital lamellae (fig. 18) long and slender, each with 15–20 moderately long, straight hairs over dorsal surface extending to base of lamella; ninth sternum (fig. 23) with posterior margin straight; spermatheca (fig. 32) with caplike portion longer than broad. Male genital process (fig. 9) deeply cleft in two lobes, the outer one bluntly pointed, with a few spines subapically on inner side and fine hairs on outer face; inner lobe long and slender, finger-like, with a dense patch of 10–15 short black spines on inner side at tip.

DISTRIBUTION. Gulf of California (Isla San Francisco, Isla Partida).

TYPES. Holotype male, allotype female, Isla San Francisco, Gulf of California, 24 March 1953, P. H. Arnaud, Sefton-Orca Expedition (deposited in

CAS). Paratypes, 7 males, 8 females, same data as types; 1 female, Isla Partida, 23 March 1953, P. H. Arnaud, Sefton-Orca Expedition (CAS).

DISCUSSION. This species can be recognized with certainty only by the genital characters; the long, slender genital lamellae and elongate spermathecae of the female and the long, fingerlike inner lobe with spinose tip of the male genital process are distinctive. In pinned specimens, the small size, presence of only two discal scutellar hairs, and the divergent apices of the third and fourth veins are helpful in separating *C. tenuistylus* from the species occurring with it.

LITERATURE CITED

HENNIG, W.

1958. Die Familien der Diptera Schizophora und ihre phylogenetischen Verwandtschaftsbeziehungen. Beitrage zur Entomologie, vol. 8, pp. 505-688, 365 figs.

WILLIAMS, F. X.

1938. Biological studies in Hawaiian water-loving insects. Part III. Diptera or Flies. A, Ephydriidae and Anthomyiidae. Proceedings of the Hawaiian Entomological Society, vol. 10, pp. 85-119, 1 fig., 9 pls.

WIRTH, W. W.

1951. A revision of the dipterous family Canaceidae. Bernice P. Bishop Museum Occasional Papers, vol. 20, pp. 245-275, 6 figs.
1954. A new intertidal fly from California, with notes on the genus *Nocticanace* Malloch (Diptera: Canaceidae). Pan-Pacific Entomologist vol. 30, pp. 59-62, 1 fig.

